Provision of Science-based Information and Technology in Support of the Canadian Wildland Fire Strategy

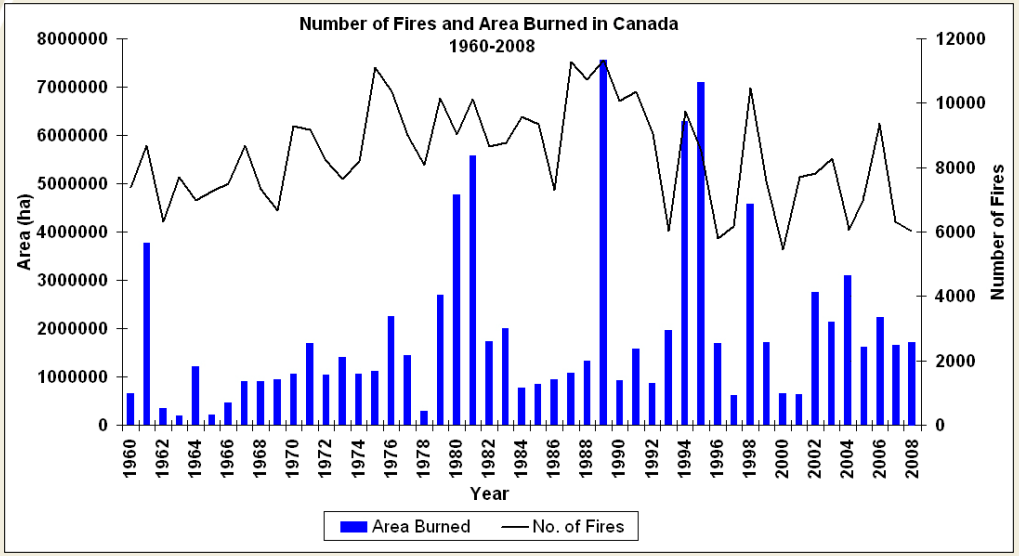
A national project of the

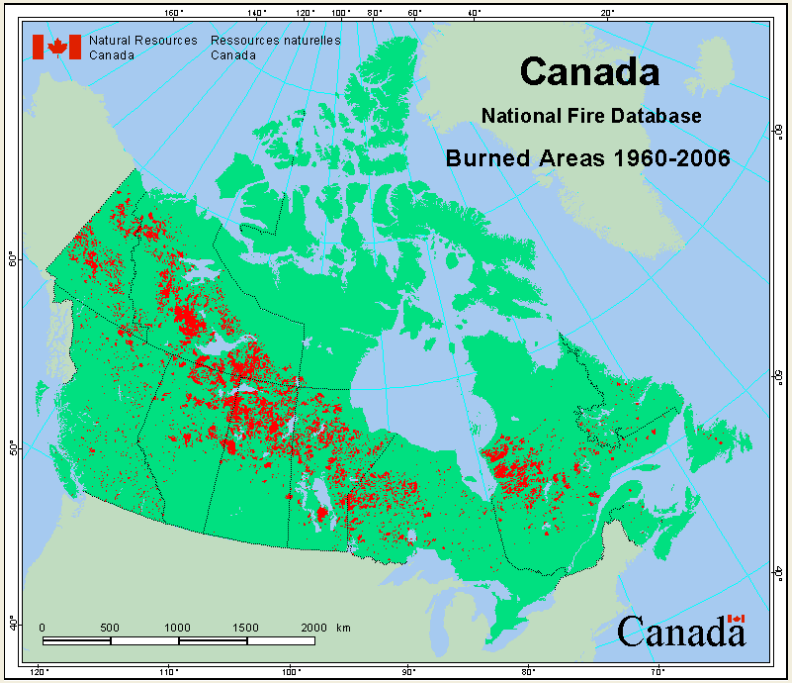
Canadian Forest Service

Wildland Fire Information Systems Group,
Northern Forestry Centre

Wildland Fire in Canada

- 2.5 million ha burned annually by 8000 fires
- >95% of area is burned by <5% of fires (mostly lightning fires)
- Dominated by large, stand replacing fires
- Lightning causes ~50% of all fires (but ~85% of area burned)





Fire Management in Canada

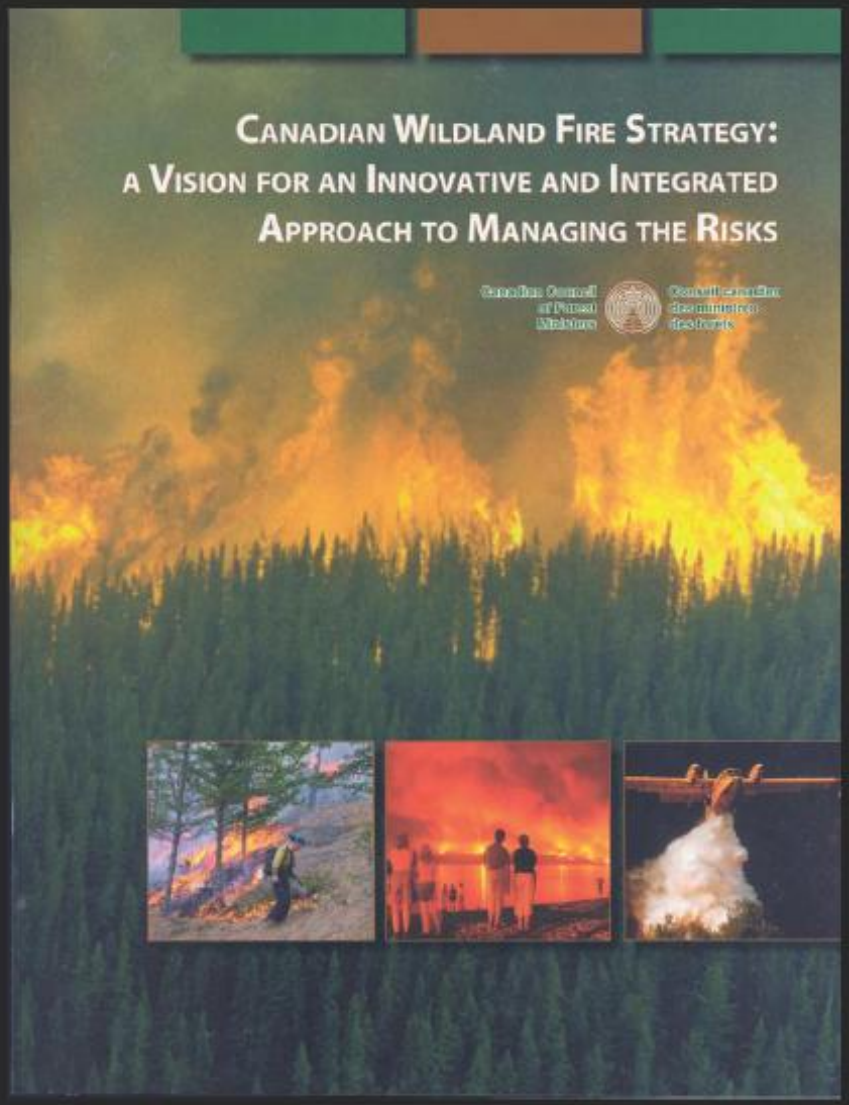
Forest fires are a major issue to:

- Safety and security of Canadians (e.g. BC 2003)
- Economic impacts (e.g. timber supply)
- Environmental (e.g. natural process, Carbon emissions)

Key legal and policy consideration:

- Forests a provincial/territorial jurisdiction
- More focused federal priorities
- Evolution of integrated fire management (CCFM)

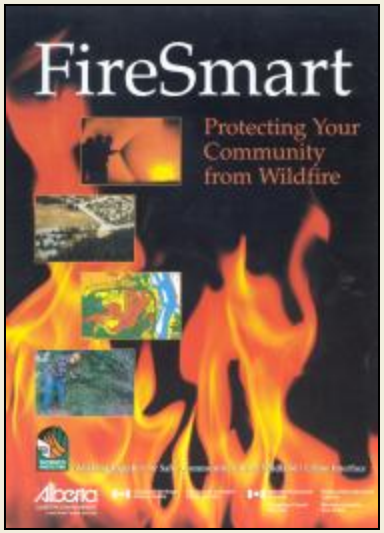
Canadian Wildland Fire Strategy



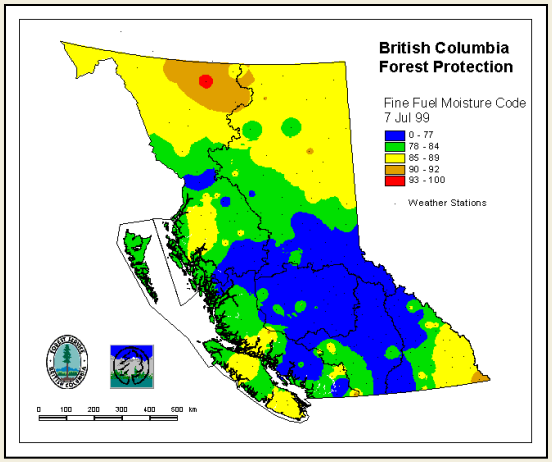
- Developed over the past 2-3 years
- Authorized by Canadian Council of Forest Ministers after 2003 fire season in western Canada (hundreds of homes lost, tens of thousands evacuated, hundreds of millions in personal property damage, and $1 billion in suppression expenditures)
- Declaration signed by all Ministers (provincial/territorial/federal) in late 2005
- Framework now in place and agreed-upon in principal by all levels of government
- Now looking for funding (estimated at $2.3 billion over next 10 years)
- Political issue now – would be helped by continuing significant fire years that focus public and political awareness

Canadian Forest Service

CFS has a long history of applying research results to develop predictive models and tools for use by fire management agencies and the public.



- Computer software
- Mathematical models
- Training and educational manuals
- Information reports



Natural Resources Canada | Ressources naturelles Canada

Canada

Canadian Forest Service Project Portfolio 2009–2010

To promote the sustainability of forests and a competitive forest sector to improve the quality of life of Canadians

NRCan Strategic Outcomes (SOs)	NRCan Program Activities (PAs)	CFS Intended Outcomes (IOs)	CFS Projects and Services
Economic Competitiveness SO-01	Economic Opportunities for Natural Resources PA 1.1	**Markets** Economic opportunities increase for the Canadian forest sector	Supporting Forest Sector Competitiveness: Economic Advice for Industry Transformation Reduction in Barriers to Trade to Maintain and Expand Markets for Canada's Forest Products Expansion of Market Opportunities for Canadian Wood Products Advancing Canada's International Forest Sector Interests Promoting Canada's Environmental Reputation Internationally
	Natural Resource-based Communities PA 1.2	**Innovation** Innovation is robust and adds economic value to each link of the forest sector's value chain—From forest to market	Development of Innovative Approaches and Tools to Optimize Canadian Wood Fibre Value Management of the Value to Wood Program Application of Genomics to Understand Forest Genetic Resources and to Improve Competitiveness Production of Desirable Wood Fibre Attributes Management of the Transformative Technologies Program Role of Bioenergy and Biorefining in a Transformed Forest Industry
Environmental Responsibility SO-02	Clean Energy PA 2.1	**Institutional** An integrated national innovation system sets strategic priorities for the forest sector	The CFS as a High-Performance Organization Is Key to a National Innovation System Implementing the CFS Knowledge Framework Development of Strategic Links in the Forest Sector Innovation System
	Ecosystem Risk Management PA 2.2	**Communities** Forest-based communities address transitional challenges and capitalize on emerging economic opportunities	Forest Communities Initiative First Nations Forestry Initiative
	Adapting to a Changing Climate and Hazard Risk Management PA 3.1	**Ecosystems** Knowledge of Canada's forest ecosystems informs and influences decision making	Assessing and Understanding Forest Productivity and Dynamics in Support of Sustainable Forest Management Provision of the National Forest Information for Monitoring Canada's Forests (NFIM) Assessing Risks to Canada's Forest Biodiversity Forest Carbon Research, Reporting and Policy Advice Supporting the International Model Forest Network
Safety, Security and Governance SO-03	Natural-Resource and Landmass Knowledge for Canadians PA 3.2	**Disturbances** Knowledge of natural and human-caused forest disturbances is used to develop adaptation options	Advancing the Implementation of a Forest Pest Strategy for Canada Forest Invasive Alien Species (FIAS) Climate Change Impacts and Adaptation Strategies for Canada's Forests and Forest Sector Integrated Pest Management (IPM) Design and Delivery of the Mountain Pine Beetle Initiative Provision of Science-based Information and Technology in Support of the Canadian Wildland Fire Strategy
	Geomatics Canada Revolving Fund PA 3.3		
	Internal Services	Internal Services	Management and Oversight Services Public Policy Services Facilities/Asset Management Services Other Support Services

Provision of Science-based Information and Technology in Support of the Canadian Wildland Fire Strategy

Collaborators

NRCan Strategic Outcome

Natural resource and landmass knowledge strengthens the safety and security of Canadians and contributes to the effective governance of Canada

NRCan Program Activities

Adapting to a changing climate and hazard risk management

CFS Intended Outcome

Knowledge of natural and human-caused forest disturbances is used to develop adaptation options

CFS Project

Provision of Science-based Information and Technology in Support of the Canadian Wildland Fire Strategy

Output	Output	Output	Output	Output	Output
A Canadian Wildland Fire Information System	An Enhanced Canadian Forest Fire Danger Rating System	An Assessment of Wildland Fire Impacts on the Canadian Forest and Wildland Urban Interface	Strategic Coordination of Wildland Fire Science and Management in Canada	Options for Wildland Fire Hazard Mitigation are Developed	The effects of Climate Change on Wildland Fire are Understood

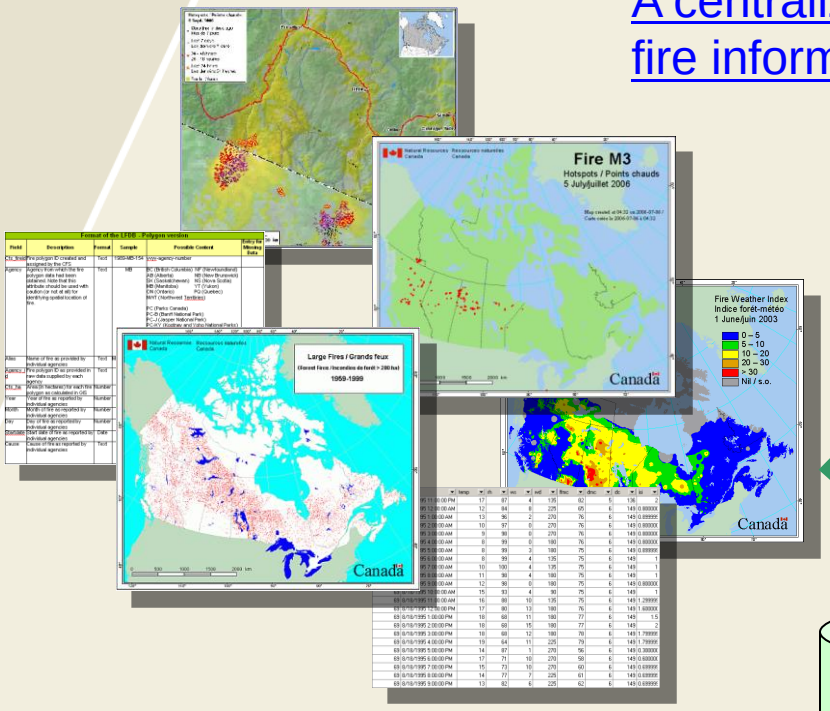
Canadian Wildland Fire Information System

Components:

- **Data and Information Systems and Services** (RS/JL)
- Integration of Infra-red Sensors for Applications in Forest Fire Monitoring and Modelling (TL)
- **National and International Reporting, and S&T Cooperation** (MB)
- **National Fire Management Resource Demand Model** (ST/KA)
- **Operational and Scientific Applications** (PE/KA)
- **Public Safety and Awareness** (RC/EN)
- **Fire Monitoring, Accounting and Reporting System** [Fire-MARS] (KA/WG/TL)

Canadian Wildland Fire Information System

[A centralized data warehouse for all national fire information]



Data warehouse is the foundation of the Canadian Wildland Fire Information System (CWFIS)

Data collected from international, federal and provincial/territorial sources

Provides information for public safety/emergency preparedness reporting as well as scientific studies and analysis

Fire Data Warehouse

Data access through the National Forest Information System (NFIS) and CFSNet

"Service CWFIS"

- **Management Accountability Framework developed by TB**
  - 10 Key Elements
  - CWFIS included in the "Citizen Focused Service" element
- **Required to complete a self assessment (Winter 2008)**
  - TB concludes that CWFIS is a service
- **Required to submit supporting evidence (Fall 2008)**
  - Lines of evidence include online surveys, CMT
  - Adherence to service standards – i.e. accessibility, availability (CLF 2.0)

Canadian Wildland Fire Information System

International Collaboration

- Adaptation locally
- Operational systems

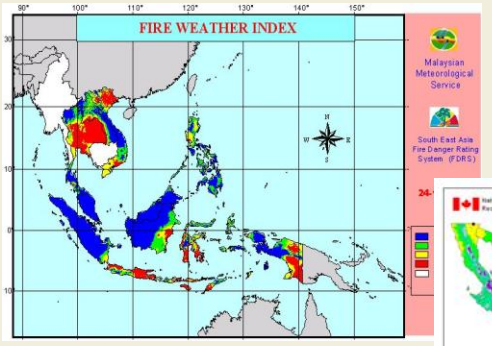
CWFIS: Canadian Wildland Fire Information System
SEAFDRS: Southeast Asia Fire Danger Rating System
Mexico Fire Weather Information System
New Zealand Fire Weather
Eurasian Experimental Fire Weather Information System

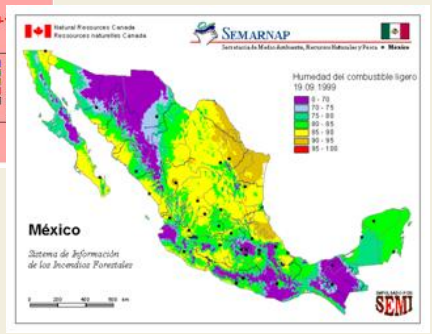
- Applications for fire management
- Fire networks

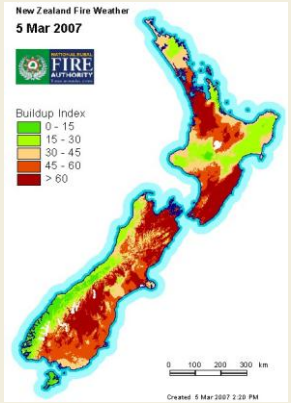
GOFC-GOLD: Global Observation of Forest and Land Cover Dynamics

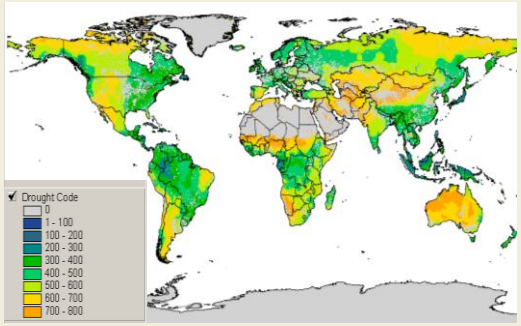
Red LatTIF: Red Latinoamericana de Incendios Forestales

Fire Danger Rating Systems



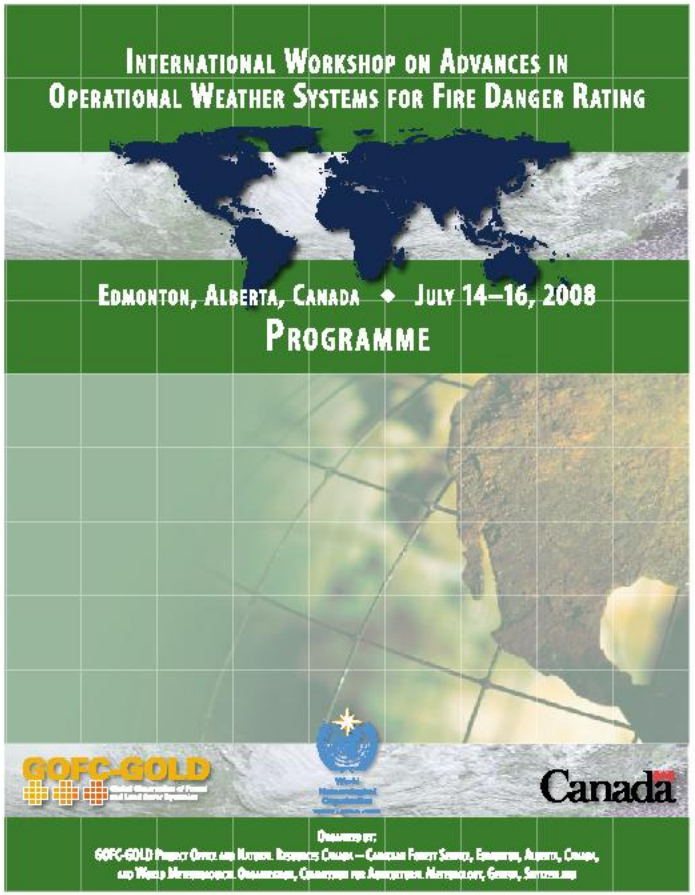






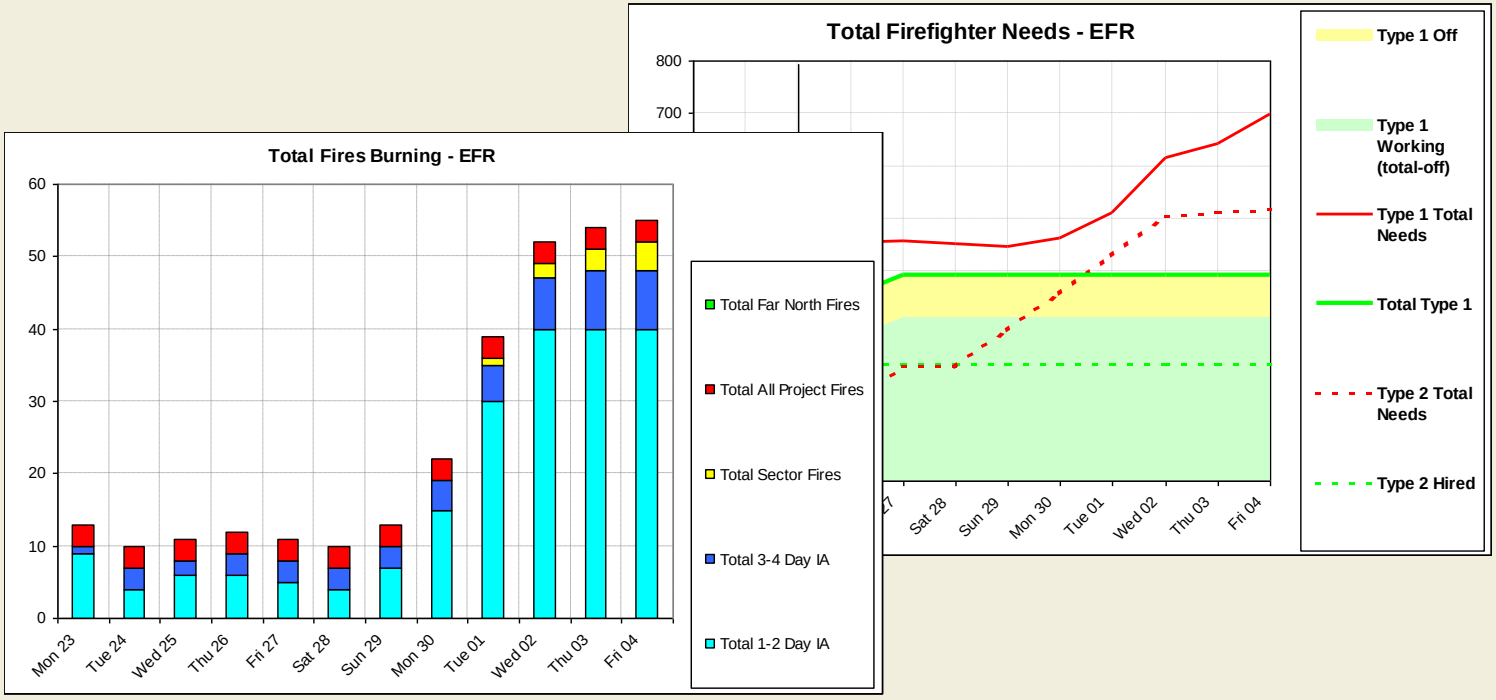
Canadian Wildland Fire Information System

WFIS Group now preparing proceedings with WMO for publication



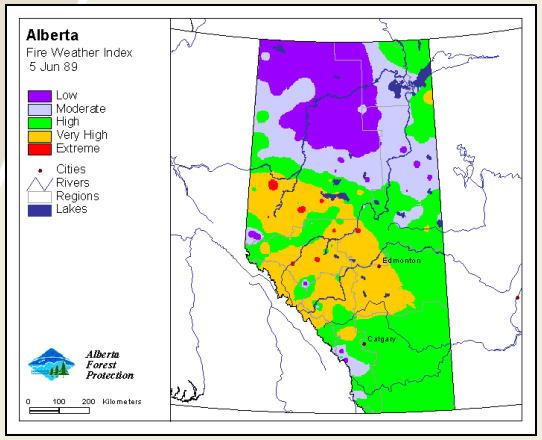
National Fire Management Resource Demand Model

A daily model of resource availability to enhance national resource sharing and support a National Response Plan



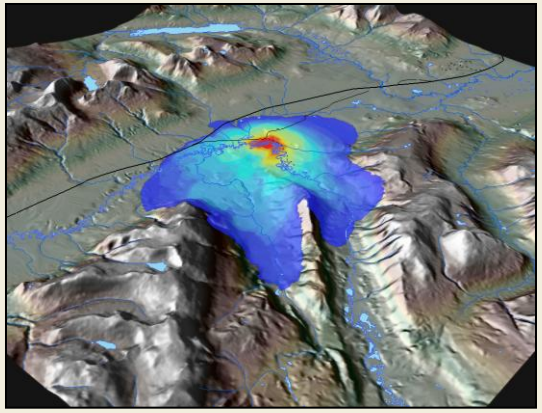
Operational and Scientific Applications

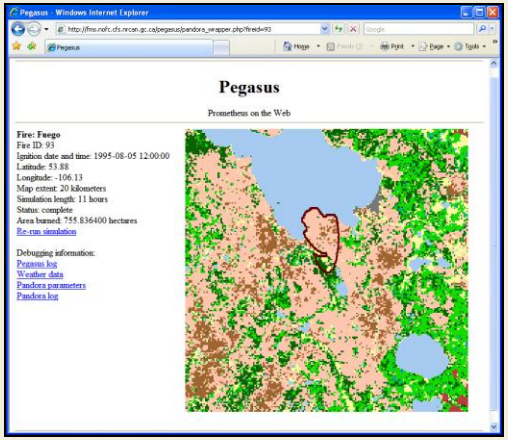
Models and applications are being developed for the Canadian Forest Fire Danger Rating System (CFFDRS).



Fire weather conditions are monitored and mapped using geographic information systems (GIS).

Fire susceptibility models are used for landscape-level planning and community protection

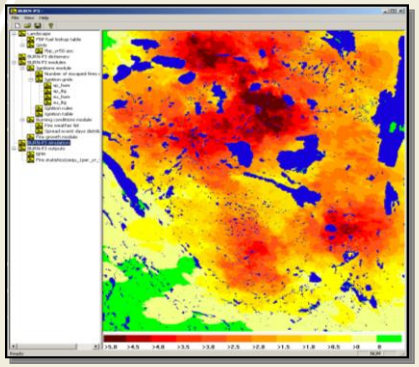




Fire spread models are used in operations and for planning and assessing burns

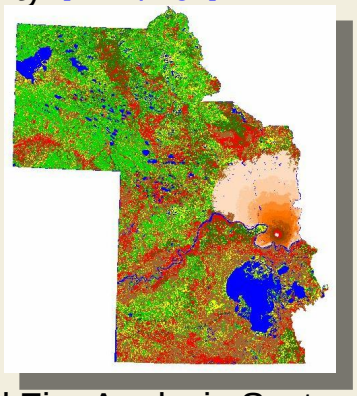
Canadian Wildland Fire Information System

Fire Growth Modelling Applications



Burn-P3

Estimating burn probability / susceptibility [web page]

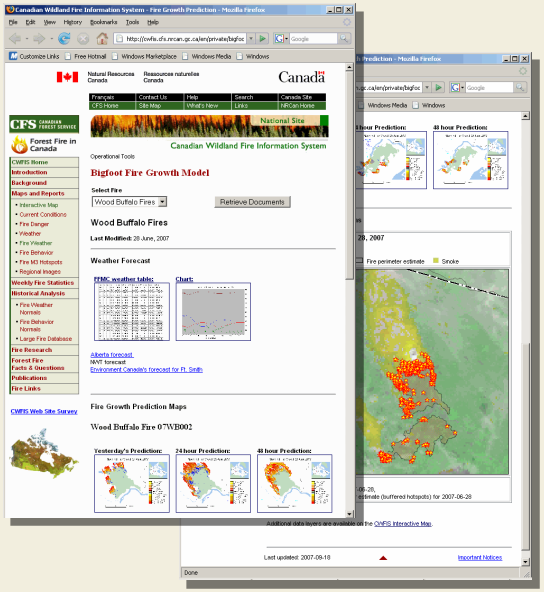


PFAS

Prescribed Fire Analysis System

Bigfoot

Hotspot-based operational fire-growth predictions



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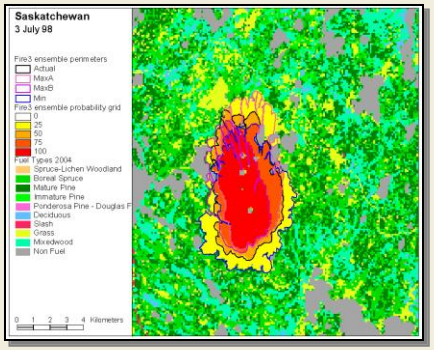

Pandora

Making the Prometheus "fire engine" available to custom applications

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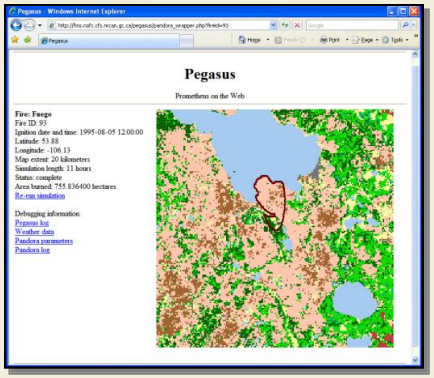
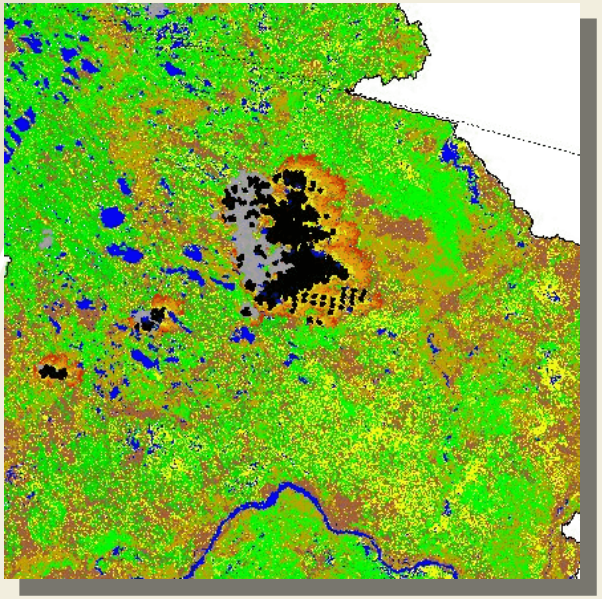


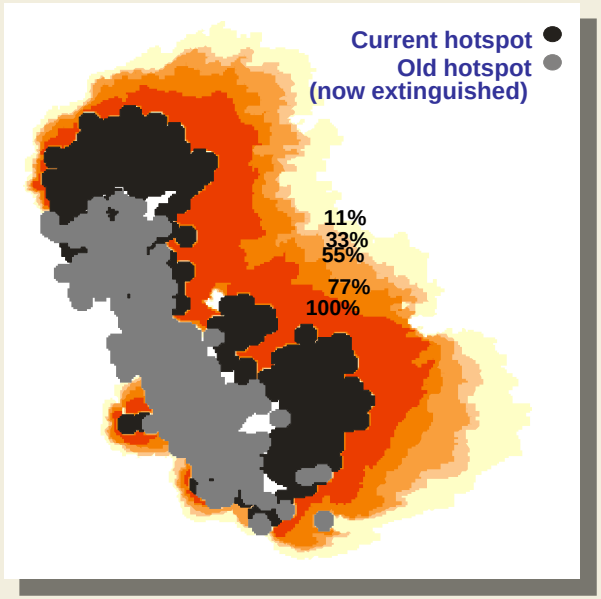
Pegasus

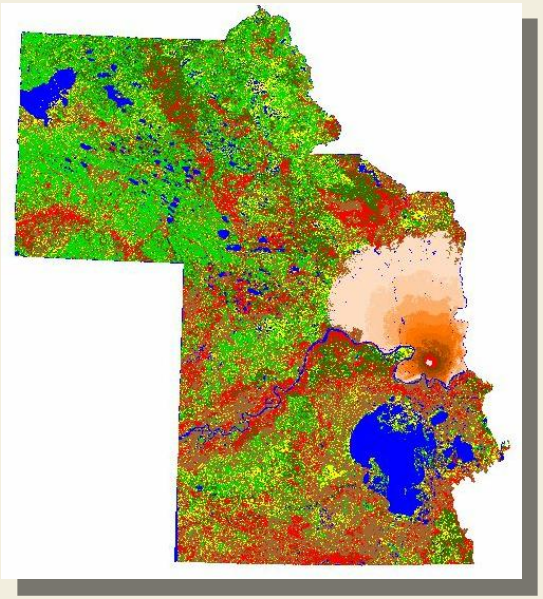
Running fire spread simulations over the web

Canadian Wildland Fire Information System

Prescribed Fire Analysis System







Short-range

- *hourly*
- *deterministic*

Medium-range

- *daily*
- *ensemble*

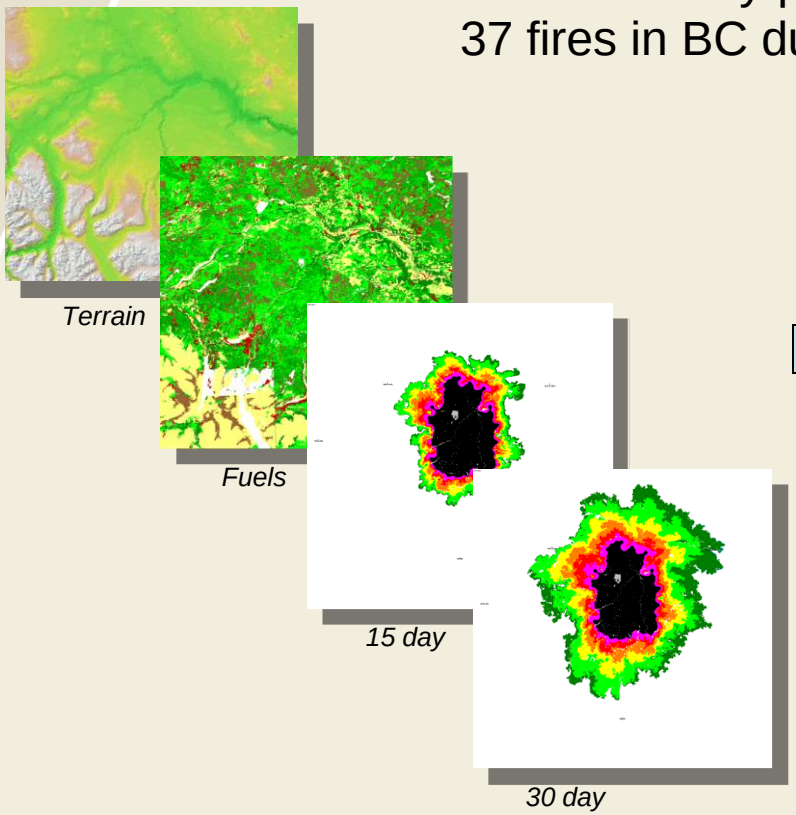
Long-range

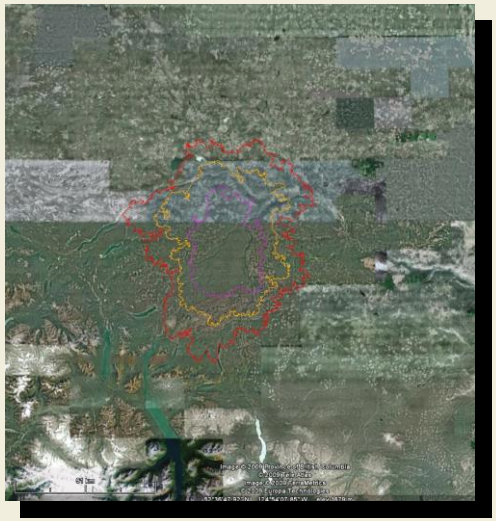
- *weekly*
- *probabilistic*

Prescribed Fire Analysis System

BC - 2009

15 and 30 day projections were made for
37 fires in BC during the 2009 fire season



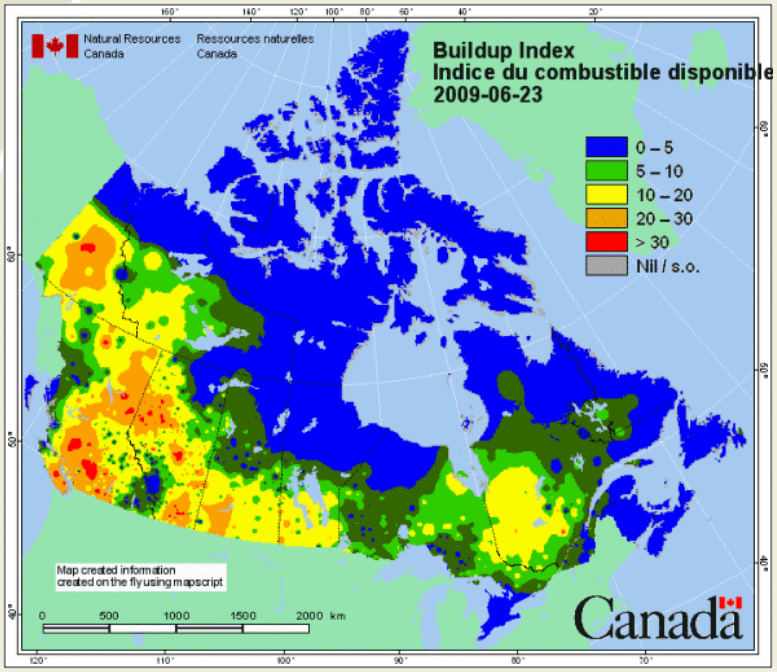


Fire Growth Projection (Prescribed Fire Analysis System)

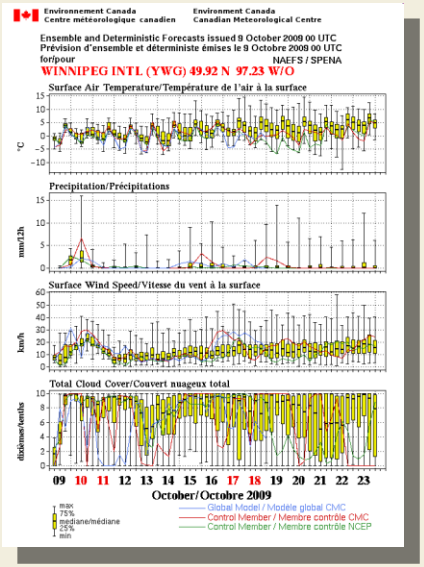
- Current fire perimeter (approx 76 000 ha)
- 15 day area at risk (approx 180 000 ha) (50 % probability)
- 30 day area at risk (approx 317 000 ha) (50 % probability)

Canadian Wildland Fire Information System

15 day forecasts of fire danger



Extended-range forecasts provided by the North American Ensemble Forecast System (NAEFS) are being incorporated into the CWFIS and the CIFFC Resource demand project.



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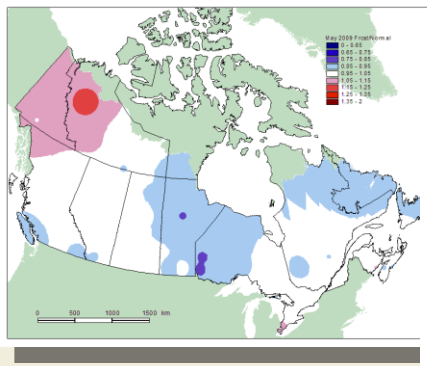
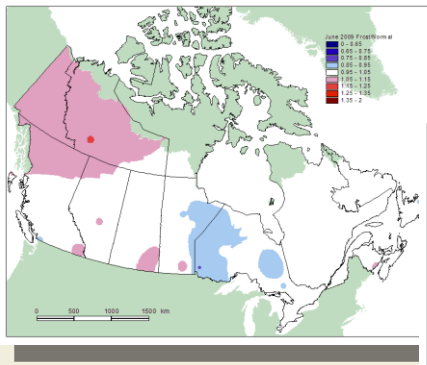
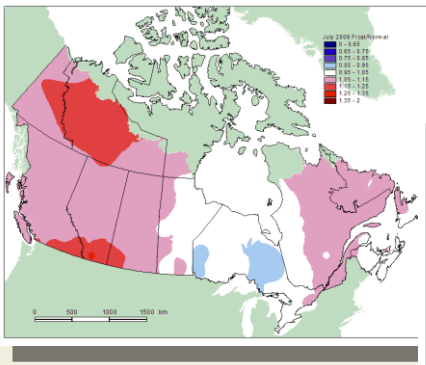
Monthly forecasts of fire danger



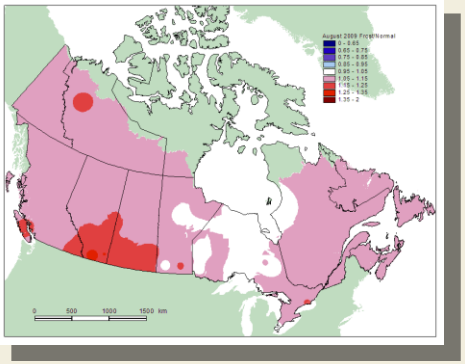
May



June



July



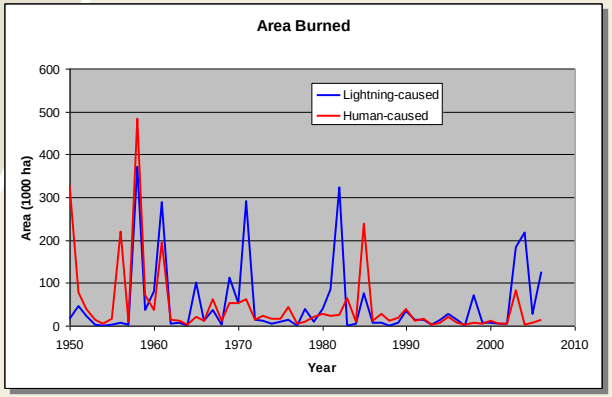
August

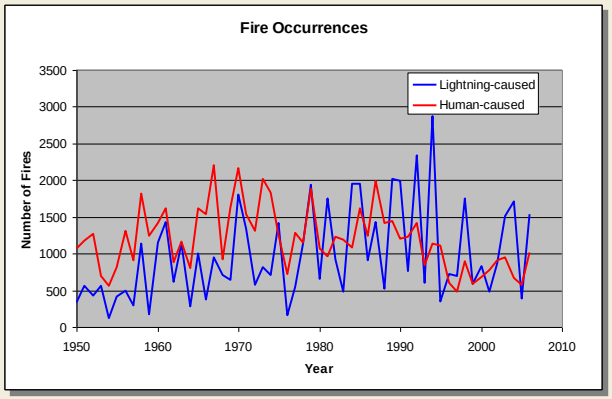
Forecasts based upon CWFIS and Environment Canada's seasonal predictions.

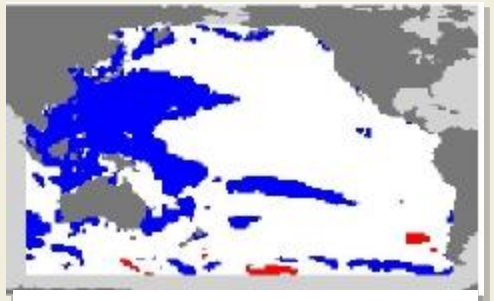
These contribute to North American seasonal outlooks and Canada's emergency preparedness plan.

[web page]

Sea surface temperatures and fire

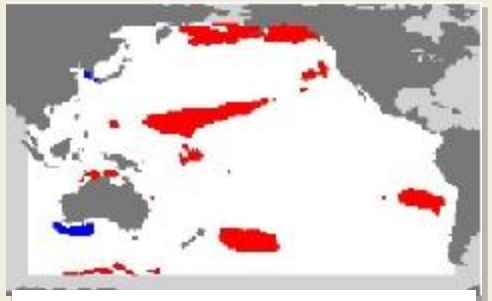






Area burned due to humans

2 year lag

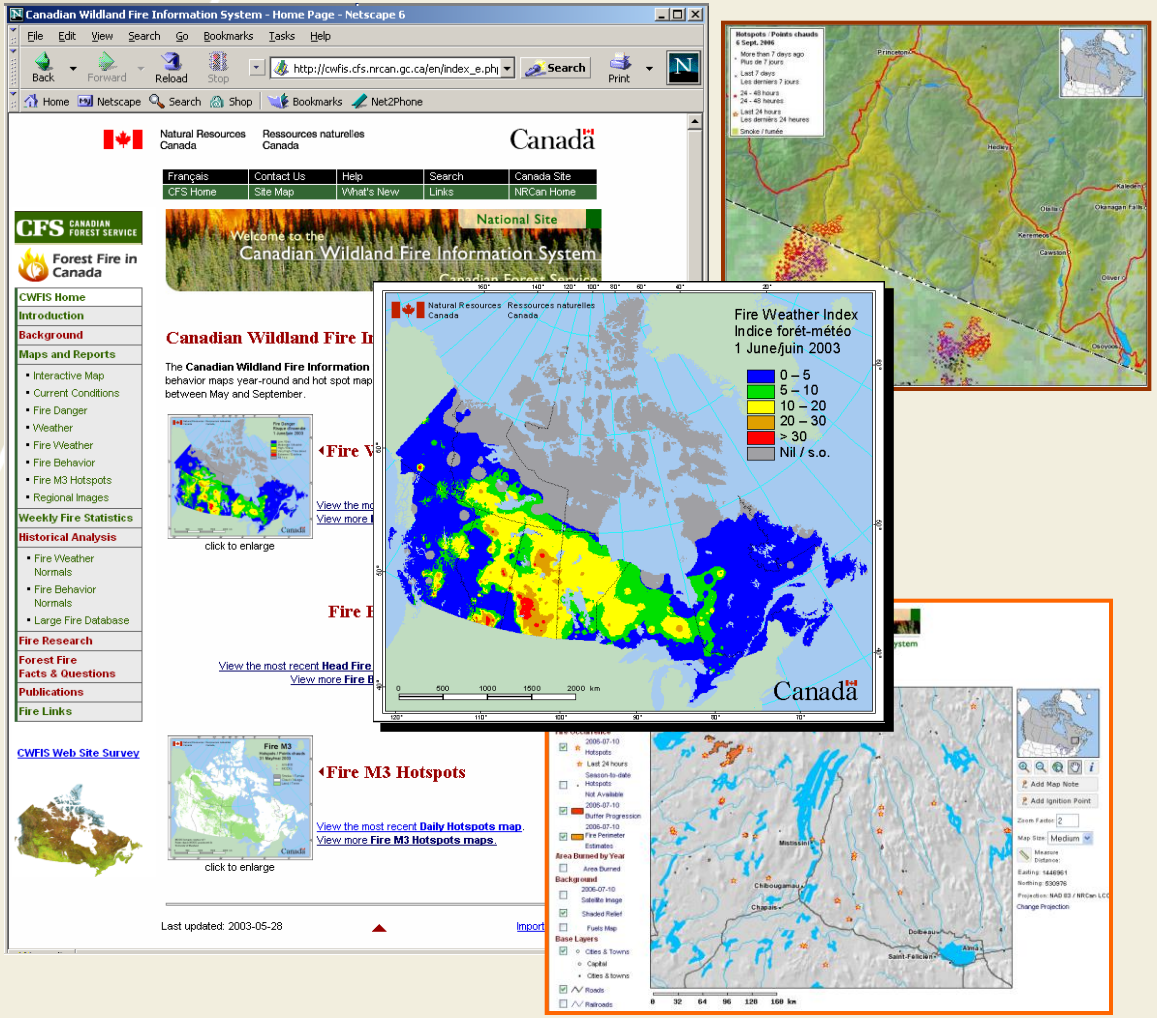


Area burned due to lightning

1 year lag

Teleconnection between BC forest fires and the ENSO are examined by calculating correlations between fire activities and Pacific SST.

Canadian Wildland Fire Information System



The ***Canadian Wildland Fire Information System*** web site provides current national information including:

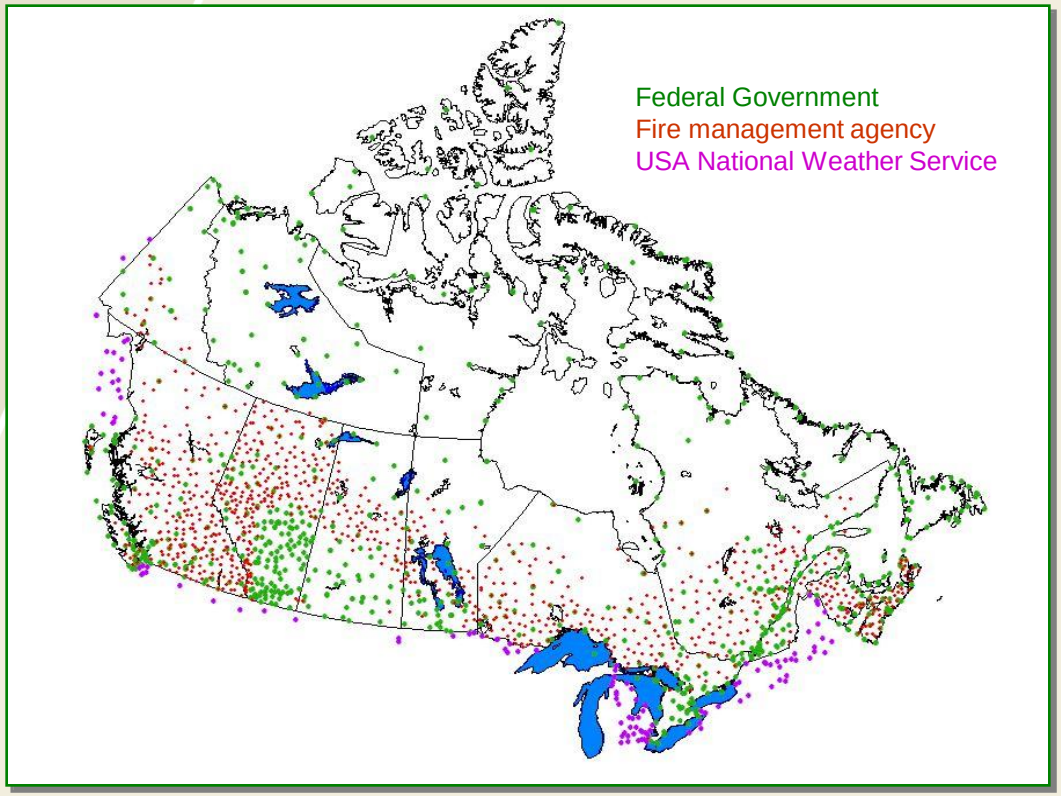
- Fire danger and behavior
- Fire and smoke locations
- Weekly statistics
- Links to provincial agencies

Supports operational response and emergency preparedness programs of

- NRCan
- Public Safety Canada
- CIFFC

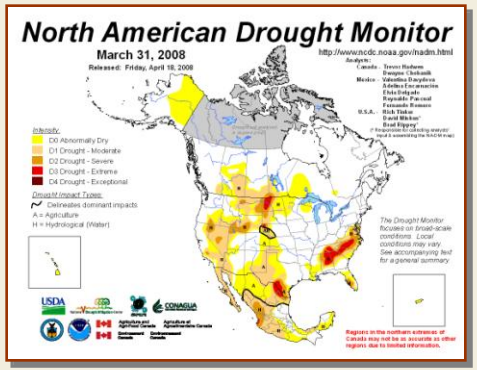
[web page]

Canadian Wildland Fire Information System



Currently, weather data is collected from over 1500 federal, provincial and territorial agencies:

- Environment Canada (800)
- Parks Canada (20)
- Provinces/Territories
  (e.g. Alberta 160, Yukon 20, etc.)
- US (75)

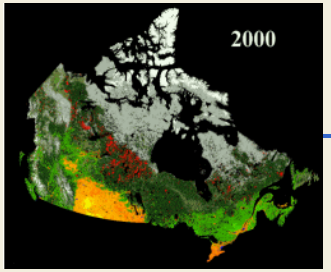


Data from the CWFIS contributes to other systems.

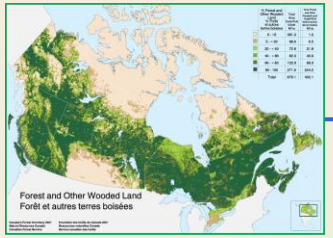
National FBP Fuel Types Map

Nadeau et al. (2005)

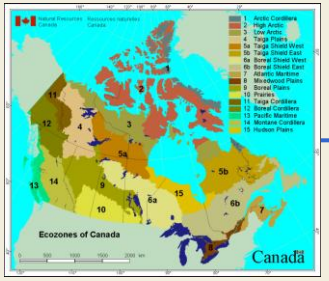
SPOT VGT Land Cover

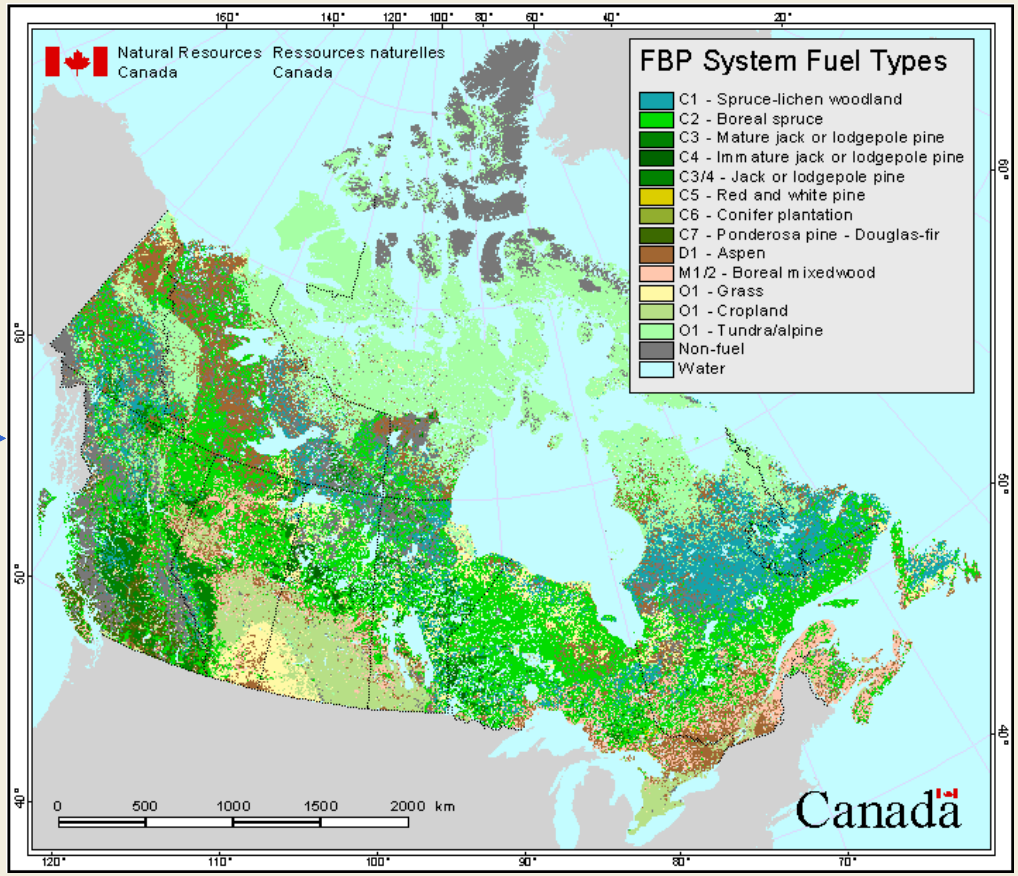


Forest Inventory (CanFI)



Ecozones & Ecoregions

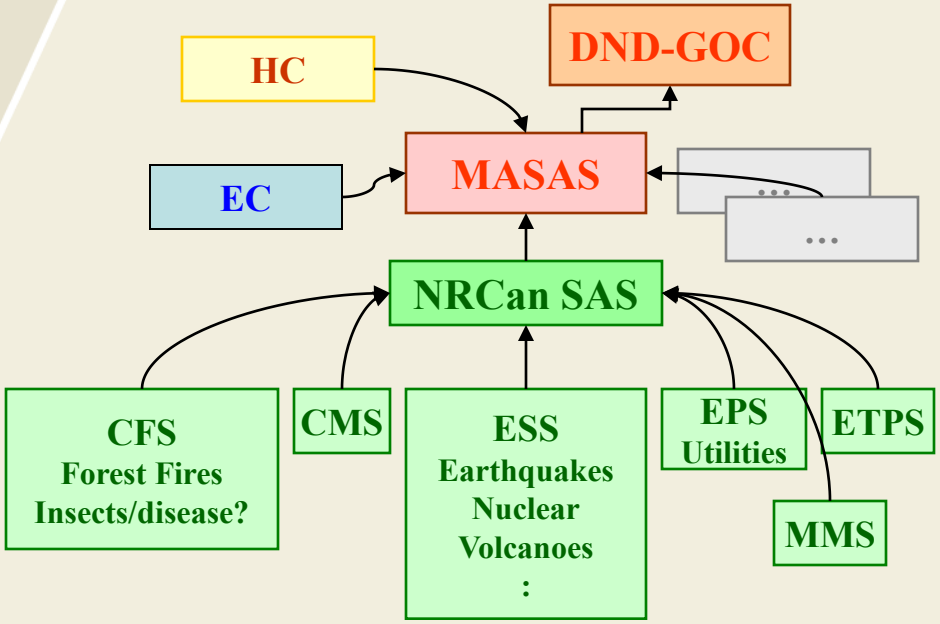




Emergency Management Programs

Emergency Preparedness Act (1985); Emergencies Act (1988)
Departmental Planning Responsibilities for Emergency Preparedness (1995)
Government Emergency Book (1995)
Emergency Management Act (2007)

NRCan emergency planning



Public Safety Canada

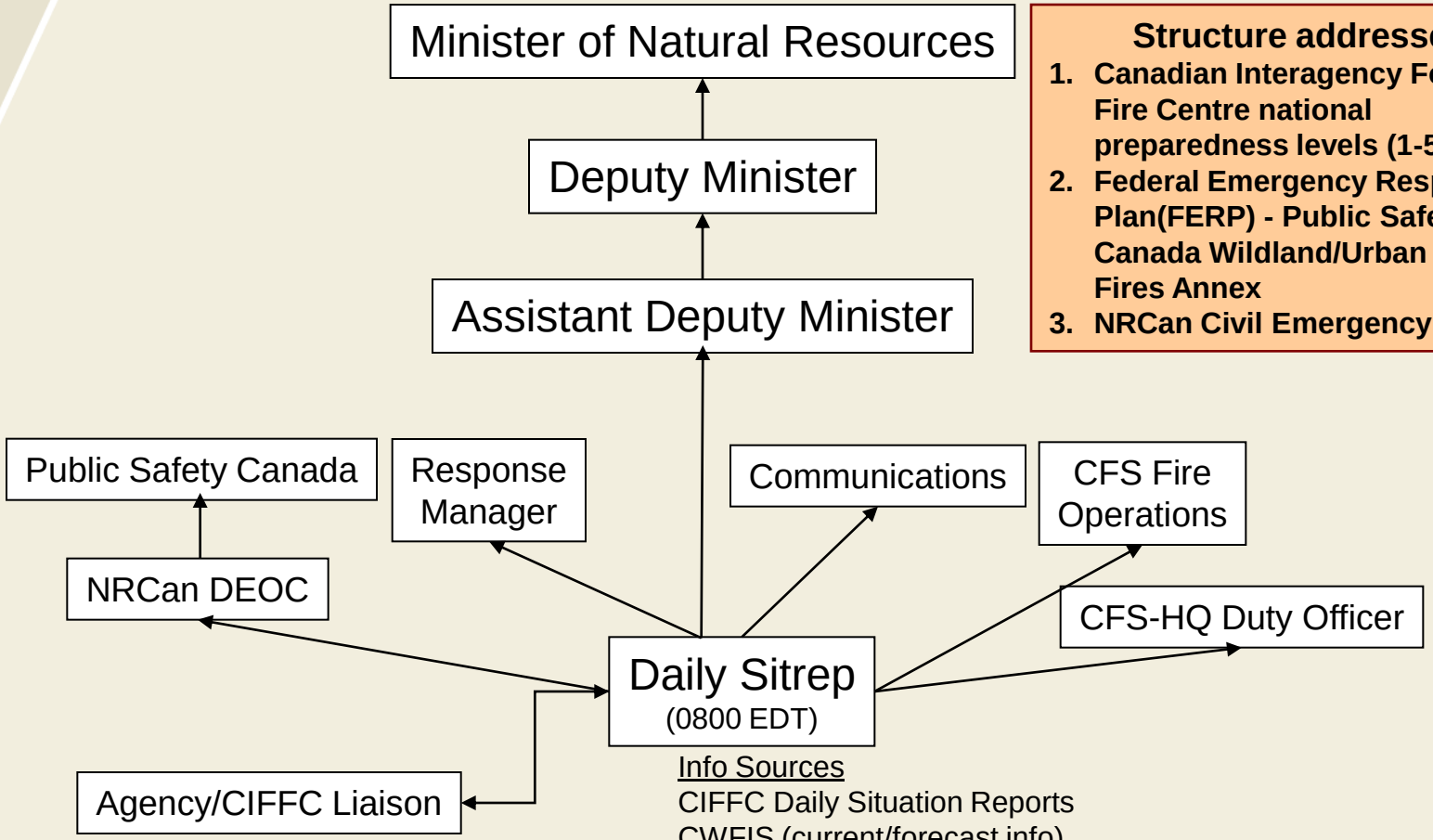
Wildland/Urban Interface Contingency Plan
- Annex in general PS plan, being revised in 2008-09

Multi-Agency Situational Awareness System (MASAS)

Natural Resources Canada

- Safety, Security, and Emergency Management
  - DEOC established in 2005
- Planning, Operations, and Information
  - National and Departmental Relations
- Preparedness levels (3)
- 11 Civil Emergency Plans
  - Revised in 2008-09, forestry plan #2, 8, 9 to merge
- Situational Awareness System (NRCan SAS)

CFS Fire Information Flow at CIFFC Preparedness Level 5

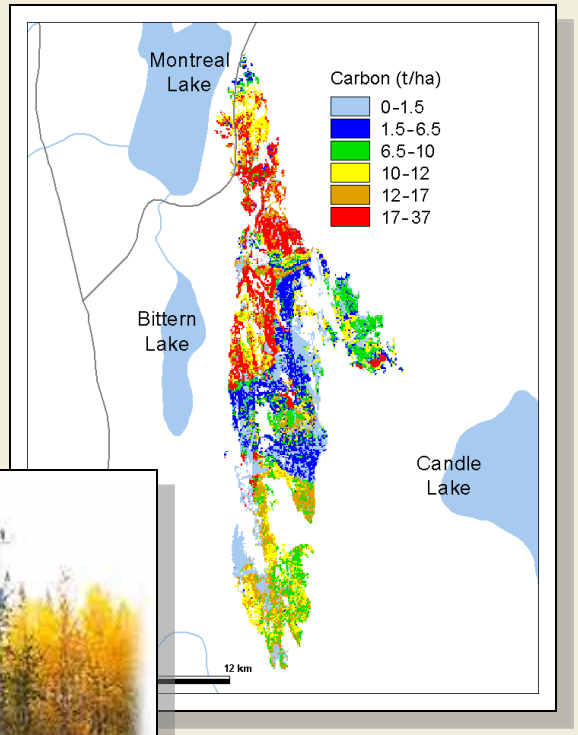


Structure addresses:

1. **Canadian Interagency Forest Fire Centre national preparedness levels (1-5)**
2. **Federal Emergency Response Plan(FERP) - Public Safety Canada Wildland/Urban Interface Fires Annex**
3. **NRCan Civil Emergency Plan**

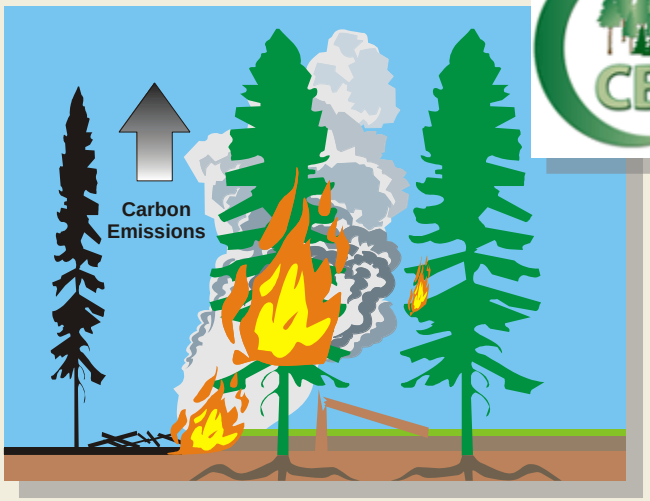
Modeling Fire Behaviour and Carbon Emissions

A joint NRCan project by CFS and ESS-CCRS

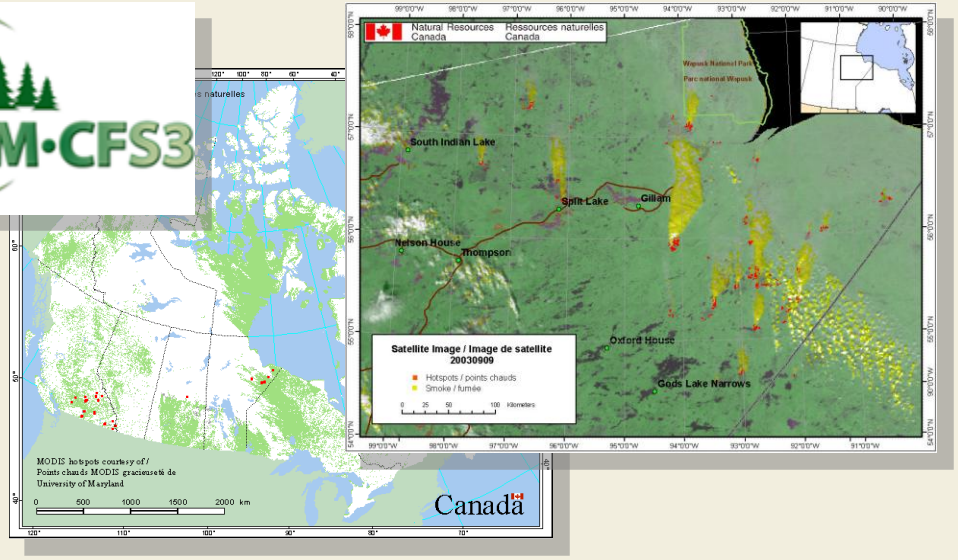


Modeling Fire Behaviour and Carbon Emissions

The BORFIRE fire effects model is combined with the CFS-CBM3 carbon budget model to estimate carbon emissions.



CBM·CFS3



Annual national fire statistics collected through remote sensing provide a means of calculating carbon emissions from Canada's forests for UNFCCC reporting.

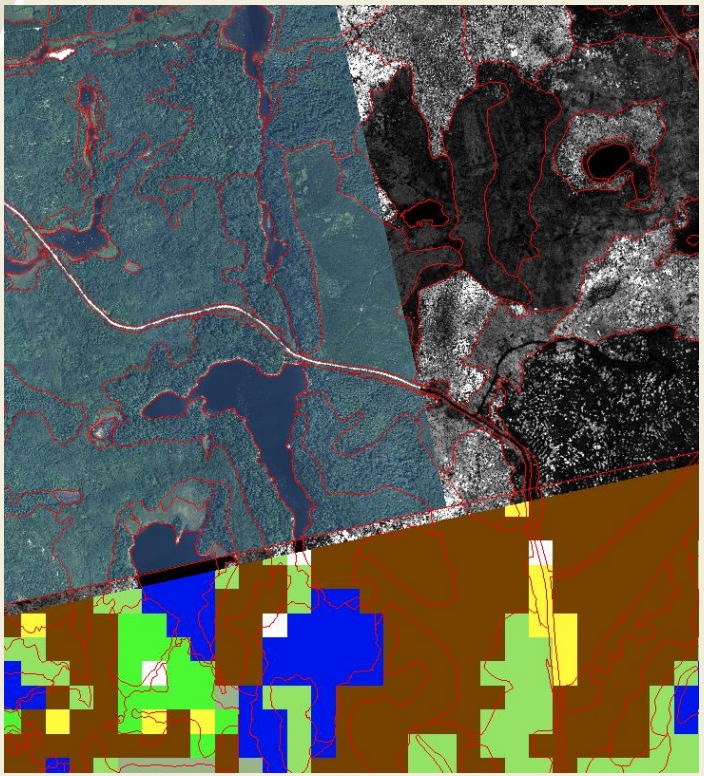
An Enhanced Canadian Forest Fire Danger Rating System

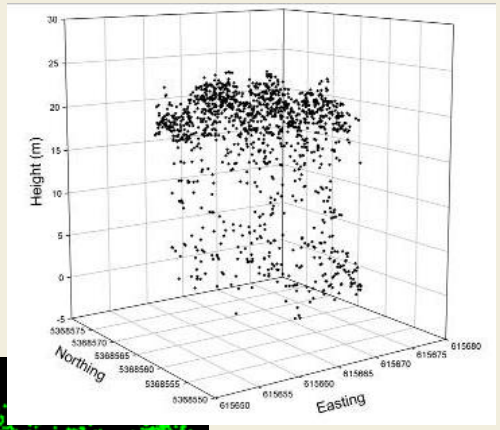
Components:

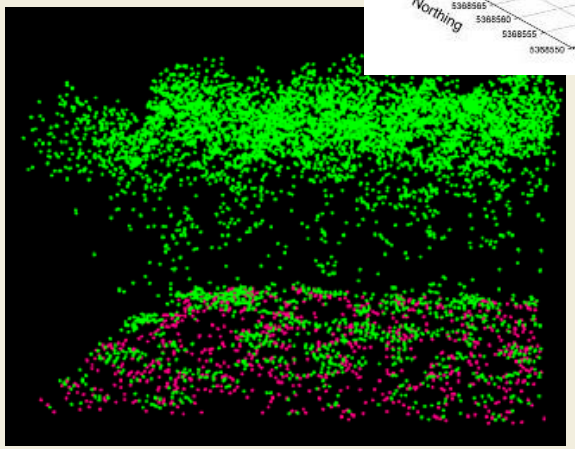
- An improved mixedwood model for the FBP System (DM)
- Characterization of in-stand weather (MF)
- **Dynamic Wildland Fuel Models** (WG/KA)
- Fire behaviour and hazard of insect-killed Canadian forests (BH)
- **Fire Occurrence Prediction** (KA/BMW)
- **Fire Radiative Energy (FRE) for estimating forest fuel consumption in boreal forests** (TL)
- Improving Drought Code (DC) Adjustments with Remote Sensing (CK-H)
- Influence of fuel properties and weather on fuel moisture and fire behaviour (BMW)
- **National Fire Effects Model (CANFIRE)** (WG)
- Next generation CFFDRS working group (BMW)
- Relationship between fire spread and non-flammable landscape features (fuel breaks) (JB)
- Seasonal fire danger indicators and forecast methods (ST)

Modernized Canadian Forest Fire Danger Rating System

Dynamic models of Canadian forest fuels



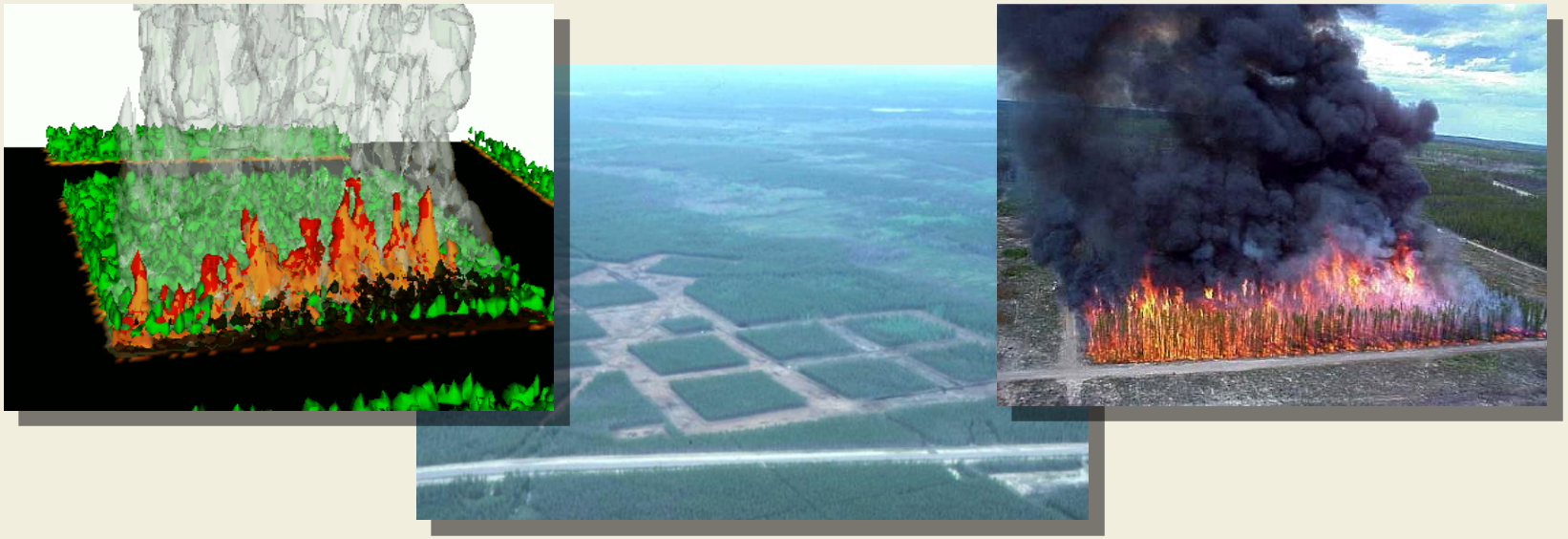




Using LiDAR to enhance fuel-type mapping

Dynamic models of Canadian forest fuels

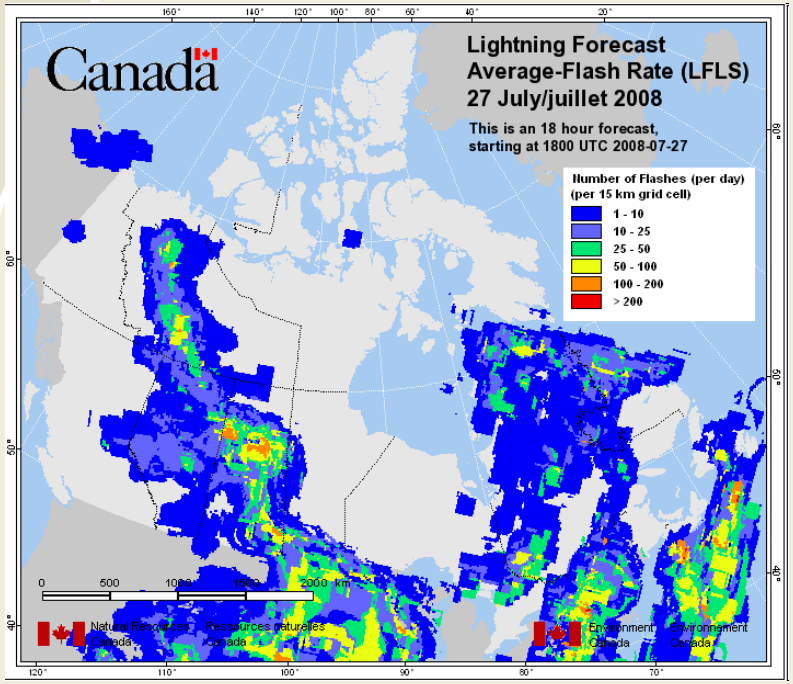
The FIRETEC (LANL) computation fluid dynamic model provides a means of conducting virtual prescribed burn experiments to study fire behaviour.



This work will provide a basis for including stand characteristics in the Canadian Forest Fire Behaviour Prediction (FBP) System

Modernized Canadian Forest Fire Danger Rating System

Fire Occurrence Prediction



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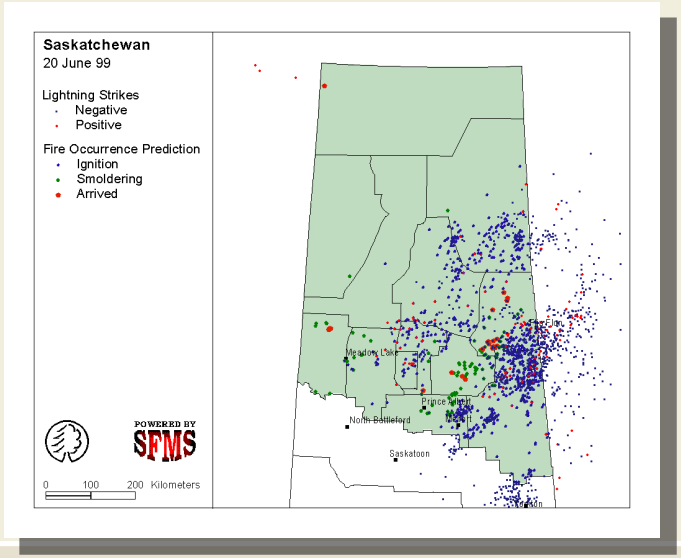
Lightning predictions provided by Environment Canada will be combined with fire occurrence prediction models to predict fire numbers and locations as part of the CIFFC Resource demand project.



Fire Radiative Energy and Fuel Consumption

8,000 ha prescribed burn
Nordegg, AB

CFS, Alberta SRD, Parks Canada,
Kings College (London, UK)

Tim Lynham,
Doug McRae,
Chelene Krezek-Hanes,
Lynn Gowman
Great Lakes Forestry Centre

Canadian Fire Effects Model (CanFIRE)

- Developing new fuel consumption and fire behaviour models for the ‘Next Generation’ Canadian Forest Fire Danger Rating System
- Includes immediate site impacts and postfire ecology response (mortality, regeneration, successional modeling)

An Assessment of Wildland Fire Impacts on the Canadian Forest and Wildland Urban Interface

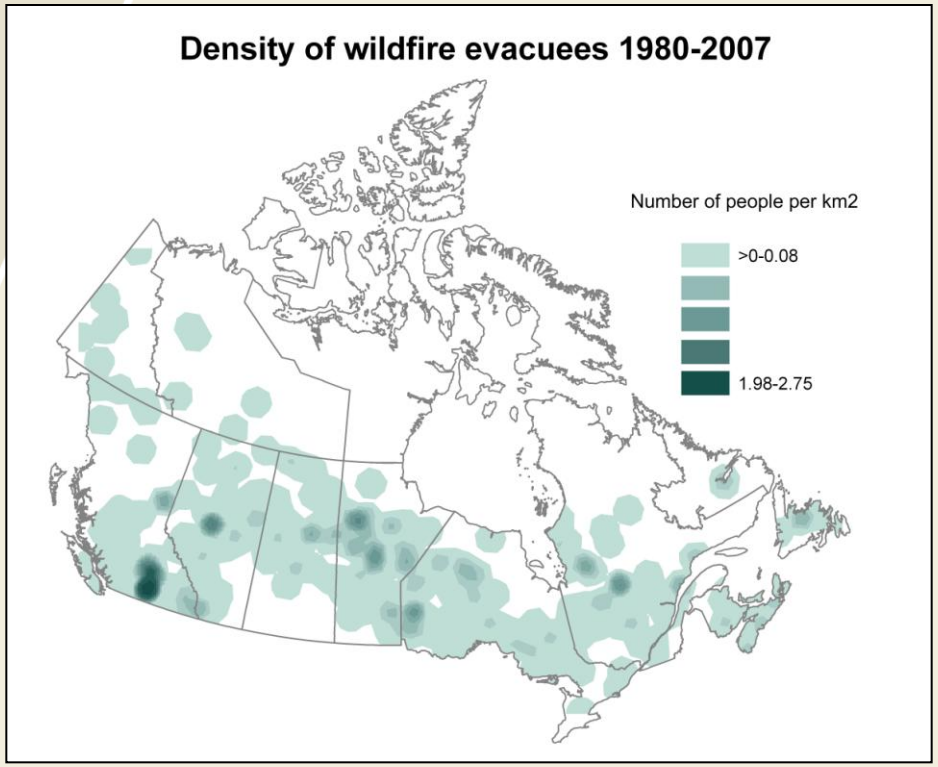
Components:

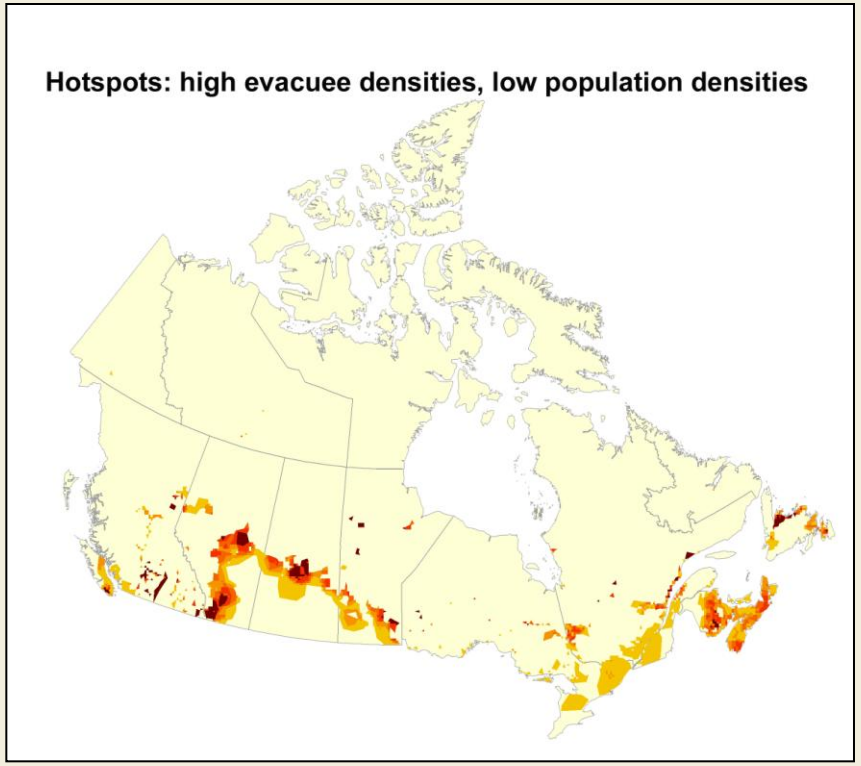
- **Canadian wildland urban interface risk analysis** (ST)
- Current and future wildland urban interface in Ontario (LG)
- **Incidence of community evacuations due to wildfire in Canada** (JB)
- Landscape Fire Modelling (MF)
- **Media analysis of community effects and impacts of wildland fire in Canada** (EN)
- **Smoke Management** (KA)
- The Far North Science Panel in Ontario (TL)

Wildland Urban Interface

- On average a total of 5500 people are evacuated from 10 communities per year
- On average 20 communities with about 70,000 people are threatened by large fires each year
- Reasons for evacuations
  - Threat life/property 62%
  - Smoke and health 14%
  - Transportation 3%
  - Unknown 21%

Wildfire evacuations in Canada 1980-2007





Jen Beverly, Northern Forestry Centre, jbeverly@nrcan.gc.ca

An Assessment of Wildland Fire Impacts on the Canadian Forest and Wildland Urban Interface

Media analysis of community effects and impacts of wildland fire in Canada

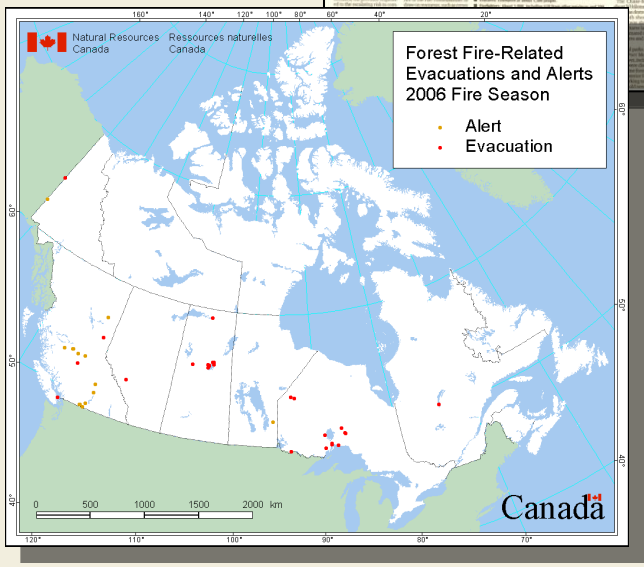

Winds thwart firefighters' efforts in B.C.

Identify impacts of wildland fire in Canada

- capture the type of information that Canadians are exposed
- track community responses to impacts of wildland fires

Issues that are monitored include:

- community evacuations and alerts
- health issues
- risk to infrastructure
- timber threats
- impact on tourism
- climate change
- mountain pine beetle
- prescribed burning
- protection and prevention



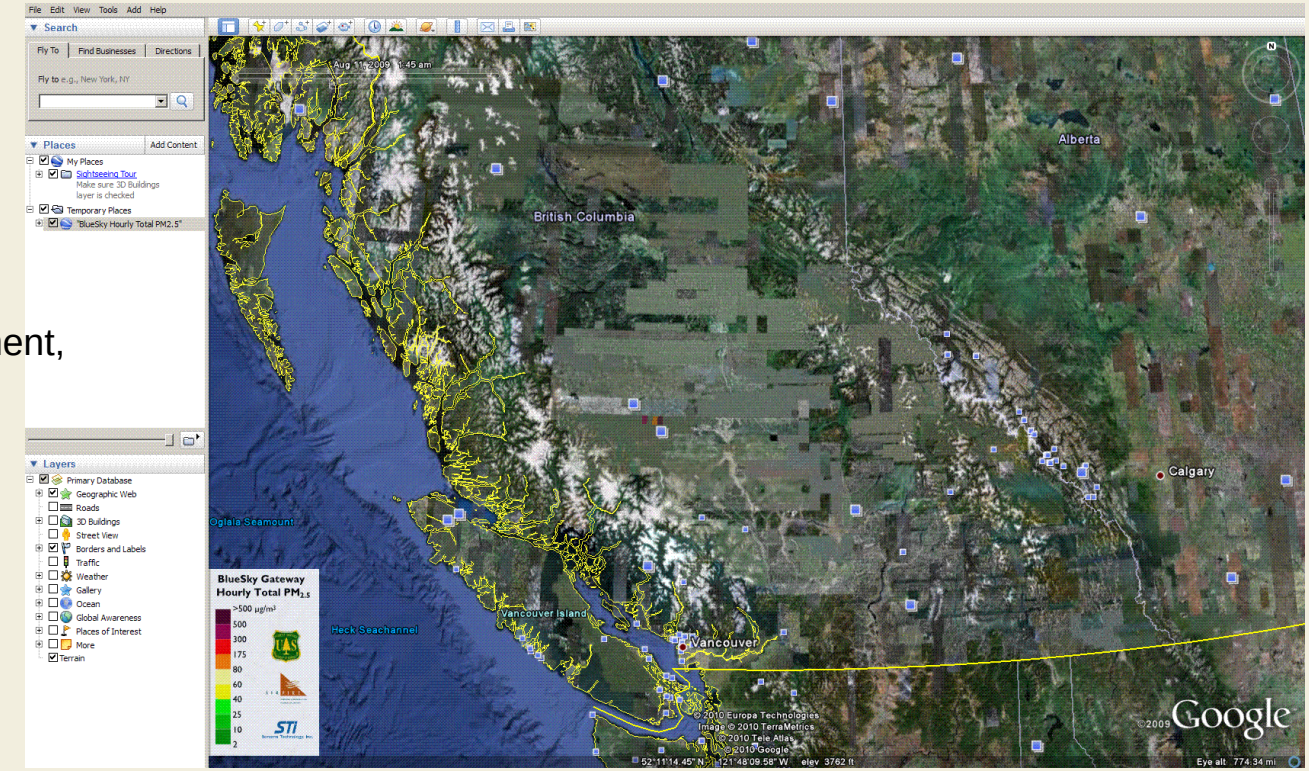
An Assessment of Wildland Fire Impacts on the Canadian Forest and Wildland Urban Interface

Smoke Management

Developing smoke forecasting models will be beneficial to Canadians as well as the international community.

Collaborators include:

- Environment Canada,
- BC Ministry of Environment,
- Alberta Ministry of Environment,
- Alberta SRD
- UBC
- USDA Forest Service



Other Outputs

Options for Wildland Fire Hazard Mitigation are Developed

* Human Dimensions of Wildfire Risk Mitigation at the Wildland-urban Interface

Strategic Coordination of Wildland Fire Science and Management in Canada

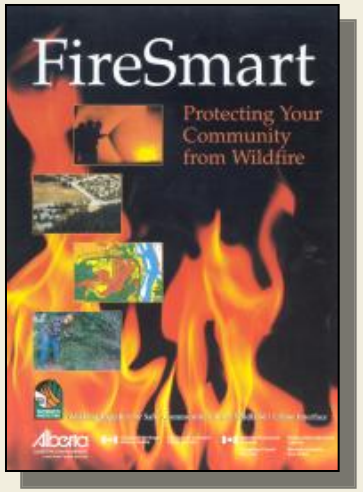
* Economic evaluation and development of a wildland fire science and technology initiatives
* HQ Fire coordination services
* Support for the 1st Canadian Wildland Fire Conference 2010

The effects of Climate Change on Wildland Fire are Understood

* Future escape fire scenarios for Canada's forested ecoregions
* Impacts of climate change (CC) on fire regimes and vegetation in Canadian Clay Belt forests

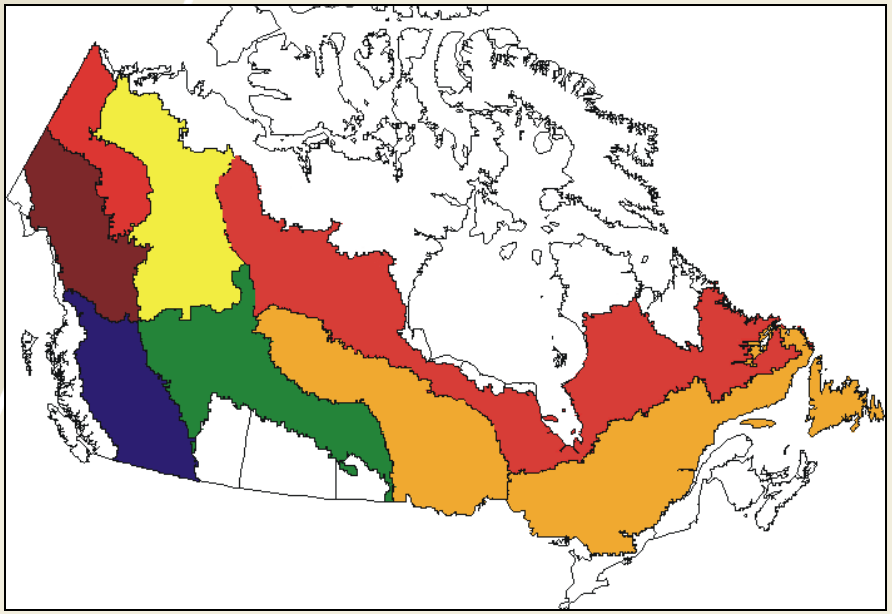
Human Dimensions of Risk Mitigation at the Wildland-urban Interface

- Aimed at providing guidance to resource managers and policy makers on:
  - public response to management options
  - empowering the public to take action to mitigate wildfire risk (e.g., FireSmart)
- Current research:
  - Public perception of the risk, mitigation activities, constraints to mitigation, and acceptance of fire management options near communities
  - What influences community/homeowner mitigation? (individual, institutional, and community influences)

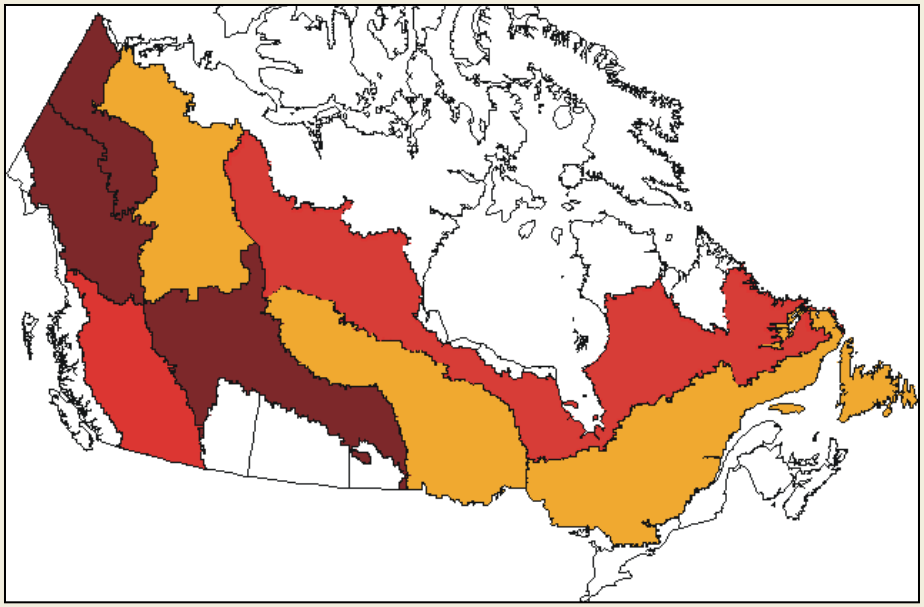


The effects of Climate Change on Wildland Fire are Understood

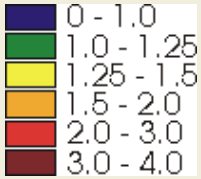
Area Burned Projections



Canadian –3xCO_2



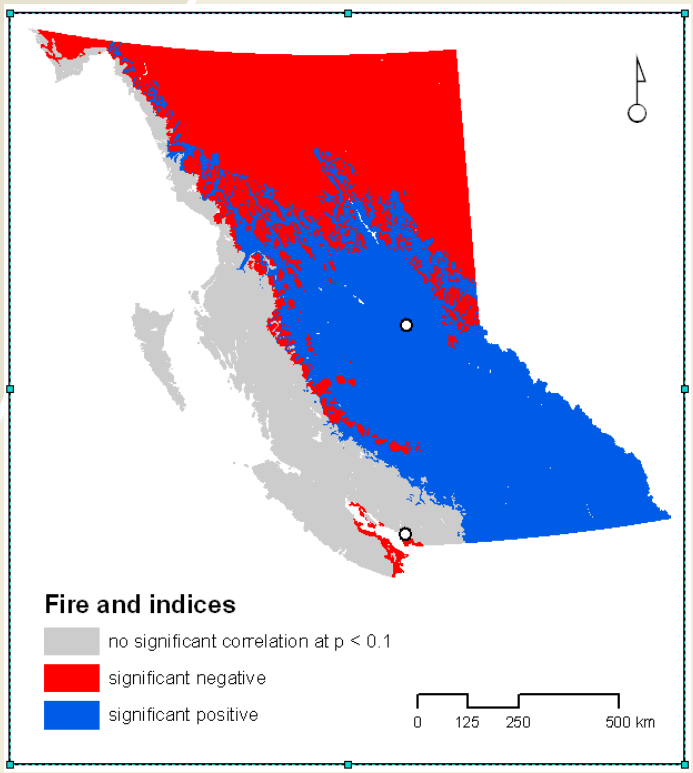
Hadley –3xCO_2



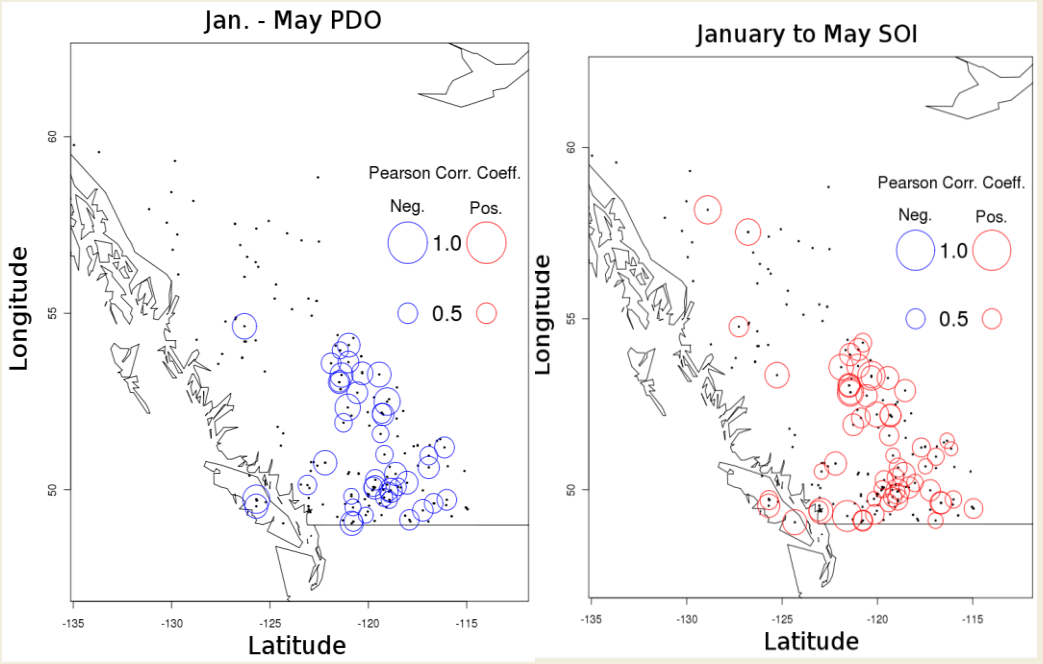
Recent studies suggest area burned will increase significantly this century due to climate change. The work above suggest a doubling of current fire activity by 2100 but other studies suggest a 6 fold increase.

Mike Flannigan, Great Lakes Forestry Centre, mike.flannigan@nrcan.gc.ca

The effects of Climate Change on Wildland Fire are Understood



Regional variation, processes



Collaborators

Provincial/Territorial

British Columbia Forest Service
Alberta Government
Saskatchewan Environment and Resource Management
Manitoba Conservation
Ontario
SOPFEU – Société de protection des forêts contre le feu
New Nouveau Brunswick Canada
Prince Edward Island Canada
Newfoundland Labrador
Nova Scotia
Yukon Government
Northwest Territories Environment and Natural Resources

National

NFIS National Forest Information System
Natural Resources Canada – Earth Sciences Sector – Canada Centre for Remote Sensing
CIFFC
The Atlas of Canada 100 years 1906 – 2006
Public Safety Canada / Sécurité publique Canada
Environment Canada / Environnement Canada
Parks Canada / Parcs Canada
Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada
CSA ASC
National Defence / Défense nationale
Canadian International Development Agency / Agence canadienne de développement international
The Weather Network – theweathernetwork.com

International

USDA Forest Service
CONAFOR – Comisión Nacional Forestal
United Nations
International Strategy for Disaster Reduction – ISDR
FAO – Fiat Panis
ASEAN
National Rural Fire Authority

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Thank you – Questions?